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Nevada County, California

(U.S.) National Eutrophication Survey, Corvallis, OR

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
BOCA RESERVOIR
NEVADA COUNTY
CALIFORNIA
EPA REGION IX
WORKING PAPER No. 740

WITH THE COOPERATION OF THE
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
AND THE
CALIFORNIA NATIONAL GUARD
JUNE, 1978

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F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentration (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the California State Water Resources Control Board and the nine Regional Water Quality Control Boards for professional involvement, to the California National Guard for conducting the tributary sampling phase of the Survey, and to those California wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Division of Planning and Research of the State Water Resources Control Board provided invaluable lake documentation and counsel during the Survey, coordinated the reviews of the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

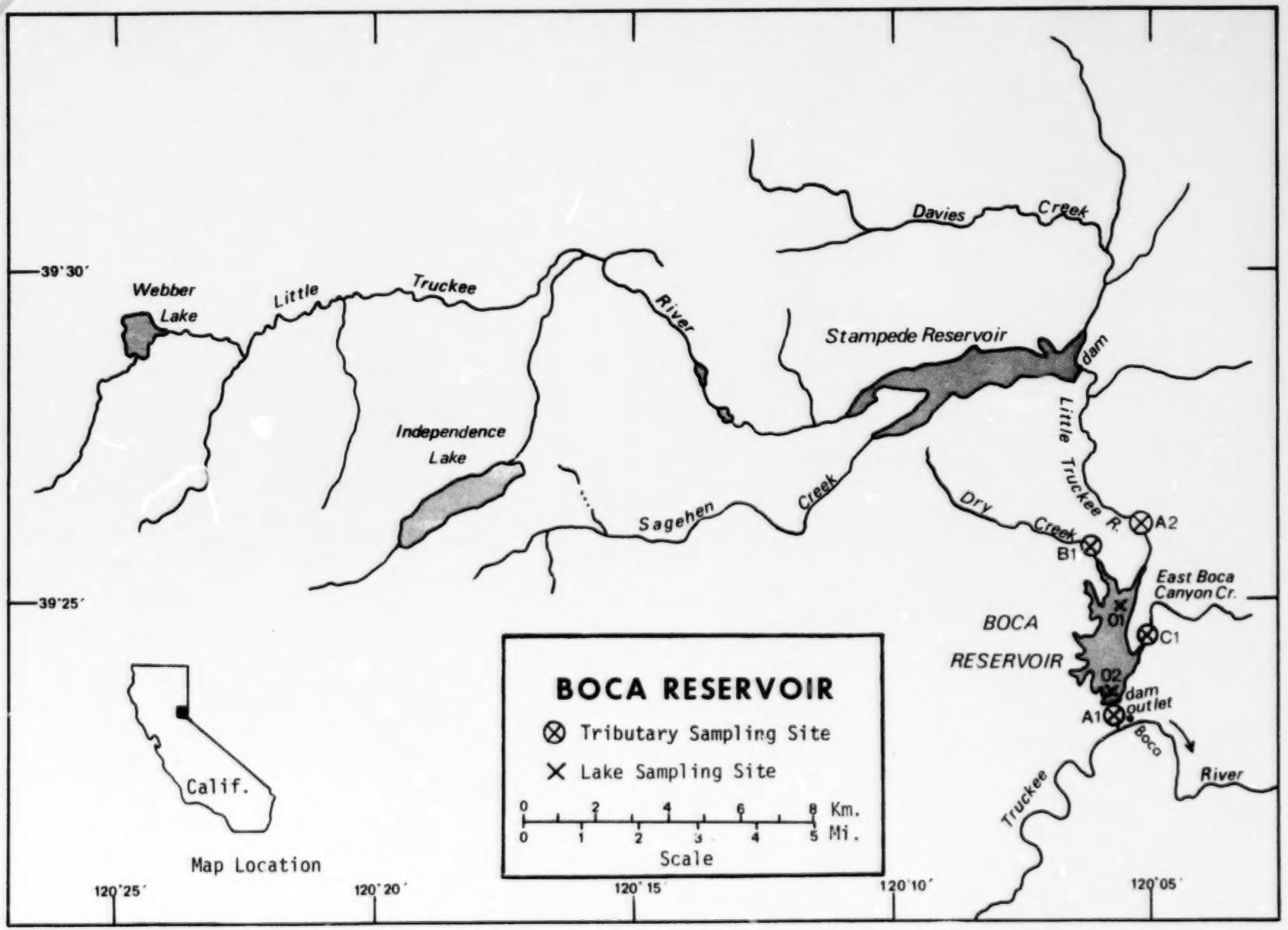
Major General Glen C. Ames, the Adjutant General of California, and Project Officer Second Lieutenant Terry L. Barrie, who directed the volunteer efforts of the California National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of California

Name	County
Amador	Amador
Boca	Nevada
Britton	Shasta
Casitas	Ventura
Crowley	Mono
Don Pedro	Tuolumne
Elsinore	Riverside
Fallen Leaf	El Dorado
Hennessey	Napa
Henshaw	San Diego
Iron Gate	Siskiyou
Lopez	San Luis Obispo
Mary	Mono
Mendocino	Mendocino
Nicasio	Marin
Lower Otay	San Diego
Pillsbury	Lake
Santa Margarita	San Luis Obispo
Shasta	Shasta
Shaver	Fresno
Silver	Mono
Tahoe	El Dorado, Placer, CA; Carson City, Douglas, Washoe, NV
Tulloch	Calaveras, Tuolumne
Lower Twin	Mono
Upper Twin	Mono


39°30′
39°25′
Webber Lake
Little Truckee River
Truckee
Davies Creek
Stampede Reservoir
dam
Independence Lake
Sagehen Creek
Dry Creek
Little Truckee R.
A2
B1
East Boca Canyon Cr.
BOCA RESERVOIR
01
C1
02
dam outlet
A1
Boca
River
Truckee
Calif.
Map Location
BOCA RESERVOIR
Tributary Sampling Site
Lake Sampling Site
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
120°25′
120°20′
120°15′
120°10′
120°05′

BOCA RESERVOIR

STORET NO. 0602

I. CONCLUSIONS

A. Trophic Condition*:

Survey data indicate Boca Reservoir is oligotrophic. It ranked first in overall quality when the 24 California lakes and reservoirs sampled in 1975 were compared using a combination if six parameters**. Two of the water bodies had less and one the same median total phosphorus, one had less and two had the same median orthophosphorus, none had less but four had the same inorganic nitrogen, one had less and one had the same mean chlorophyll a, and seven had greater Secchi disc transparency.

Essentially no depression of dissolved oxygen occurred at depths as great as 20.4 meters.

B. Rate-Limiting Nutrient:

The algal assay results indicate the primary productivity of Boca Reservoir was limited by nitrogen in early June and phosphorus in November.

The reservoir data indicate nitrogen limitation on 06/30/75 and 11/04/75.

C. Nutrient Controllability:

1. Point sources--No known municipal or industrial point sources contributed phosphorus to Boca Reservoir during the sampling year.

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* Trophic assessment is based on levels of nutrients, dissolved oxygen, and chlorophyll a; phytoplankton kinds and numbers; and transparency (Allum et al., 1977

** See Appendix A

The present phosphorus loading of 0.85 $g/m^2/yr$ is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading but more than his suggested oligotrophic loading (see page 12).

2. Non-point sources-Nearly 88% of the total phosphorus input to Boca Reservoir during the sampling year was contributed by the gaged tributaries.

The East Boca Canyon Creek phosphorus export rate was a rather high 78 kg P/km^2 during the year of sampling. This rate is 7 and 13 times higher than the rates of the other two tributaries. The cause of the higher export rate is not known; however, it is noted that the mean total phosphorus concentration in the creek (0.061 mg/l) was about three times the mean concentrations in the other two streams (0.017 and 0.019 mg/l).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 3.97 kilometers^2.
2. Mean depth: 12.8 meters.
3. Maximum depth: 30.5 meters.
4. Volume: 50.820 x 10^6 m^3.
5. Mean hydraulic retention time: 112 days (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Little Truckee River	378.1	5.010
Dry Creek	16.1	0.367
East Boca Canyon Creek	6.0	0.139
Minor tributaries & immediate drainage -	41.3	0.508
Totals	441.5	6.024

2. Outlet -

Little Truckee River	445.5**	5.230

C. Precipitation***:

1. Year of sampling: 58.8 centimeters.
2. Mean annual: 53.3 centimeters.

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† Table of metric conversions--Appendix B.
†† Dendy, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Boca Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at two stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 12.5 meters at station 1 and 20.4 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR BOCA LAKE
STORET CODE 0602

PARAMETER	1ST SAMPLING (6/ 9/75) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (6/30/75) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 4/75) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	6.3 - 15.6	10.9	10.3	7.0 - 13.1	10.8	11.7	11.6 - 12.2	11.9	11.9
DISS OXY (MG/L)	8.2 - 9.8	9.2	9.2	8.2 - 9.6	9.0	9.1	8.8 - 9.4	9.1	9.2
CNDCTVY (MCROMO)	45. - 60.	53.	52.	42. - 56.	52.	54.	31. - 37.	33.	33.
PH (STAND UNITS)	7.2 - 8.1	7.9	8.0	7.5 - 7.9	7.8	7.8	7.7 - 8.0	7.9	7.9
TOT ALK (MG/L)	32. - 44.	40.	44.	36. - 43.	39.	40.	24. - 34.	30.	31.
TOT P (MG/L)	0.010 - 0.014	0.012	0.011	0.014 - 0.027	0.017	0.016	0.009 - 0.012	0.010	0.011
ORTHO P (MG/L)	0.015 - 0.023	0.019	0.019	0.002 - 0.007	0.003	0.003	0.002 - 0.002	0.002	0.002
NO2+NO3 (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.020 - 0.050	0.033	0.030	0.020 - 0.030	0.024	0.020	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.200 - 0.300	0.230	0.200	0.200 - 0.400	0.240	0.200	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.040 - 0.070	0.053	0.050	0.040 - 0.050	0.044	0.040	0.040 - 0.040	0.040	0.040
TOTAL N (MG/L)	0.220 - 0.320	0.250	0.220	0.220 - 0.420	0.260	0.220	0.220 - 0.220	0.220	0.220
CHLRPYL A (UG/L)	1.0 - 1.2	1.1	1.1	0.9 - 1.0	0.9	0.9	2.6 - 3.5	3.0	3.0
SECCHI (METERS)	1.8 - 2.0	1.9	1.9	3.7 - 3.8	3.7	3.7	4.0 - 4.3	4.1	4.1

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/09/75	1. Tabellaria sp.	120
	2. Oscillatoria sp.	90
	3. Chroomonas (?) sp.	90
	4. Centric diatoms	60
	5. Melosira sp.	60
	Other genera	62
	Total	482
06/30/75	1. Chroomonas (?) sp.	114
	2. Stephanodiscus sp.	57
	3. Asterionella sp.	57
	4. Tabellaria sp.	28
	Total	256
11/04/75	1. Tabellaria sp.	646
	2. Fragilaria sp.	258
	3. Chroomonas (?) sp.	194
	4. Cryptomonas sp.	161
	5. Asterionella sp.	129
	Total	1,388

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/09/75	1	1.2
	2	1.0
06/30/75	1	0.9
	2	1.0
11/04/75	1	3.5
	2	2.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. June sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.025	0.8
0.050 P	0.065	0.025	1.2
0.050 P + 1.0 N	0.065	1.025	27.9
1.0 N	0.015	1.025	7.2

b. November sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.030	0.2
0.050 P	0.055	0.030	3.8
0.050 P + 1.0 N	0.055	1.030	22.0
1.0 N	0.005	1.030	0.2

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Boca Reservoir was relatively low at the times the samples were collected (06/09/75 and 11/04/75). Also, the

increased yield in the June sample with the addition of only nitrogen indicates the reservoir was nitrogen limited at that time. Conversely, in the November sample, the increased yield when only phosphorus was added indicates phosphorus limitation then.

The reservoir data indicate nitrogen limitation in early June and phosphorus limitation in late June and in November; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 3/1, 15/1, and 20/1, respectively.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the California National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May and June when two samples were collected from several of the sites. Sampling was begun in November, 1974, and was completed in October, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the California District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations A-2 and B-1 and multiplying the means by the ZZ area in km^2.

No known wastewater treatment plants impacted Boca Reservoir during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Little Truckee River	2,310	68.3
Dry Creek	180	5.3
East Boca Canyon Creek	470	13.9
b. Minor tributaries & immediate drainage (non-point load) -	350	10.4
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	70	2.1
Total	3,380	100.0

2. Outputs -

Reservoir outlet - Little Truckee R. 2,675 kg.

3. Net annual P accumulation - 705 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Little Truckee River	50,170	64.2
Dry Creek	5,120	6.6
East Boca Canyon Creek	9,275	11.9
b. Minor tributaries & immediate drainage (non-point load) -	9,315	11.9
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	4,285	5.4
Total	78,165	100.0

2. Outputs -

Reservoir outlet - Little Truckee R. 72,570 kg.

3. Net annual N accumulation - 5,595 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Little Truckee River	6	133
Dry Creek	11	318
East Boca Canyon Creek	78	1,546

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.85	0.18	19.7	1.4

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Boca Reservoir:

"Dangerous" (eutrophic loading)	1.24
"Permissible" (oligotrophic loading)	0.62

V. LITERATURE REVIEWED

Allum, M.O., R.E. Glessner, and J.H. Gakstatter, 1977. An evaluation of the National Eutrophication Survey data. Working Paper No. 900, Corvallis Env. Res. Lab., Corvallis, OR.

Dendy, William B., 1974. Personal communication (waterbody information and morphometry). CA Water Res. Contr. Bd., Sacramento.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INO-G N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0601	AMADOR RESERVOIR	0.040	0.390	408.667	22.383	14.600	0.020
0602	BUCA LAKE	0.017	0.040	372.633	1.700	6.800	0.003
0603	LAKE BRITTON	0.067	0.115	448.500	4.811	11.200	0.047
0604	CASITAS RESERVOIR	0.029	0.050	400.250	3.192	14.000	0.014
0605	CROWLEY LAKE	0.044	0.045	374.750	5.600	12.200	0.034
0606	DON PEDRO RESERVOIR	0.013	0.060	381.733	3.564	11.400	0.004
0607	LAKE ELSINORE	0.469	0.120	489.214	70.572	8.000	0.092
0608	FALLEN LEAF RESERVOIR	0.007	0.040	24.357	0.786	8.800	0.005
0609	LAKE HENNESSEY	0.027	0.060	416.000	4.525	15.000	0.012
0610	LAKE HENSHAW	0.138	0.070	461.000	26.783	9.800	0.073
0611	IRON GATE RESERVOIR	0.184	0.690	440.333	6.217	13.800	0.124
0614	LOPEZ LAKE	0.371	0.090	372.000	8.658	15.000	0.343
0615	LAKE MARY	0.010	0.040	296.000	2.550	10.600	0.002
0616	LAKE MENDOCINO	0.020	0.050	436.500	3.100	9.400	0.008
0617	NICASIO RESERVOIR	0.055	0.345	482.778	6.633	9.800	0.013
0618	LOWER OTAY RESERVOIR	0.058	0.180	447.250	15.933	15.000	0.013
0619	LAKE PILLSBURY	0.022	0.060	466.667	6.389	8.200	0.008
0620	SANTA MARGARITA LAKE	0.037	0.070	400.000	9.122	14.600	0.014
0621	SHASTA LAKE	0.021	0.060	381.542	4.087	9.000	0.015
0622	SHAVER	0.014	0.050	346.400	1.700	7.400	0.004
0623	SILVER LAKE	0.012	0.055	356.000	1.800	7.000	0.003
0624	TULLOCK RESERVOIR	0.025	0.060	433.000	13.878	7.400	0.009
0625	UPPER TWIN LAKES	0.015	0.040	300.200	3.340	7.400	0.004
0626	LOWER TWIN LAKES	0.014	0.040	248.000	2.900	11.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
0601	AMADOR RESERVOIR	35 (8)	4 (1)	43 (10)	9 (2)	17 (4)	26 (6)	134
0602	BOCA LAKE	89 (20)	98 (22)	70 (16)	91 (21)	100 (23)	91 (20)	539
0603	LAKE BRITTON	17 (4)	22 (5)	17 (4)	48 (11)	43 (10)	17 (4)	164
0604	CASITAS RESERVOIR	43 (10)	74 (17)	48 (11)	70 (16)	22 (5)	37 (8)	294
0605	CROWLEY LAKE	30 (7)	78 (18)	65 (15)	43 (10)	30 (7)	22 (5)	268
0606	DON PEDRO RESERVOIR	83 (19)	54 (11)	57 (13)	61 (14)	37 (8)	78 (17)	370
0607	LAKE ELSINORE	0 (0)	17 (4)	0 (0)	0 (0)	78 (18)	9 (2)	104
0608	FALLEN LEAF RESERVOIR	100 (23)	87 (19)	100 (23)	100 (23)	70 (16)	70 (16)	527
0609	LAKE HENNESSEY	48 (11)	54 (11)	39 (9)	52 (12)	4 (0)	52 (12)	249
0610	LAKE HENSHAW	13 (3)	33 (7)	13 (3)	4 (1)	54 (12)	13 (3)	130
0611	IRON GATE RESERVOIR	9 (2)	0 (0)	26 (6)	39 (9)	26 (6)	4 (1)	104
0614	LOPEZ LAKE	4 (1)	26 (6)	74 (17)	26 (6)	4 (0)	0 (0)	134
0615	LAKE MARY	96 (22)	87 (19)	91 (21)	83 (19)	48 (11)	100 (23)	505
0616	LAKE MENDOCINO	65 (15)	70 (16)	30 (7)	74 (17)	61 (14)	63 (14)	363
0617	NICASIO RESERVOIR	26 (6)	9 (2)	4 (1)	30 (7)	54 (12)	46 (10)	169
0618	LOWER OTAY RESERVOIR	22 (5)	13 (3)	22 (5)	13 (3)	4 (0)	46 (10)	120
0619	LAKE PILLSBURY	57 (13)	41 (9)	9 (2)	35 (8)	74 (17)	63 (14)	279
0620	SANTA MARGARITA LAKE	39 (9)	33 (7)	52 (12)	22 (5)	13 (3)	37 (8)	196
0621	SHASTA LAKE	61 (14)	54 (11)	61 (14)	57 (13)	65 (15)	30 (7)	328
0622	SHAVER	78 (18)	41 (9)	83 (19)	96 (22)	87 (19)	78 (17)	463
0623	SILVER LAKE	89 (20)	65 (15)	78 (18)	87 (20)	96 (22)	91 (20)	506
0624	TULLOCK RESERVOIR	52 (12)	54 (11)	35 (8)	17 (4)	87 (19)	57 (13)	302
0625	UPPER TWIN LAKES	70 (16)	98 (22)	87 (20)	65 (15)	87 (19)	78 (17)	485
0626	LOWER TWIN LAKES	74 (17)	87 (19)	96 (22)	78 (18)	37 (8)	91 (20)	463

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0602	BOCA LAKE	539
2	0608	FALLEN LEAF RESERVOIR	527
3	0623	SILVER LAKE	506
4	0615	LAKE MARY	505
5	0625	UPPER TWIN LAKES	485
6	0626	LOWER TWIN LAKES	463
7	0622	SHAVER	463
8	0606	DON PEDRO RESERVOIR	370
9	0616	LAKE MENDOCINO	363
10	0621	SHASTA LAKE	328
11	0624	TULLOCK RESERVOIR	302
12	0604	CASITAS RESERVOIR	294
13	0619	LAKE PILLSBURY	279
14	0605	CROWLEY LAKE	268
15	0609	LAKE HENNESSEY	249
16	0620	SANTA MARGARITA LAKE	196
17	0617	NICASIO RESERVOIR	169
18	0603	LAKE BRITTON	164
19	0614	LOPEZ LAKE	134
20	0601	AMADOR RESERVOIR	134
21	0610	LAKE HENSHAW	130
22	0618	LOWER OTAY RESERVOIR	120
23	0607	LAKE ELSINORE	104
24	0611	IRON GATE RESERVOIR	104

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 04/26/78

LAKE CODE 0602 BUCA RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 445.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0602A1	445.5	2.55	2.38	2.42	10.19	12.86	10.90	5.41	5.55	3.51	3.09	1.42	1.93	5.23
0602A2	378.1	1.87	1.67	2.12	10.17	14.55	10.36	4.25	4.11	2.72	5.27	1.53	1.30	5.01
0602B1	16.1	0.127	0.096	0.481	2.322	1.218	0.008	0.006	0.003	0.003	0.006	0.068	0.074	0.367
0602C1	6.0	0.048	0.037	0.184	0.878	0.453	0.003	0.003	0.0	0.0	0.003	0.028	0.028	0.139
0602Z2	21.7	0.176	0.133	0.651	3.268	1.671	0.014	0.011	0.006	0.003	0.006	0.096	0.105	0.508

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 445.5
SUM OF SUB-DRAINAGE AREAS = 422.0
TOTAL FLOW IN = 72.09
TOTAL FLOW OUT = 62.69

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0602A1	11	74	3.436	10	4.248				
	12	74	3.653	15	3.653				
	1	75	4.672	12	3.596				
	2	75	7.334	8	11.242				
	3	75	2.945	9	2.803				
	4	75	0.595	6	0.017	19	0.051		
	5	75	14.866	4	8.637	18	14.413		
	6	75	10.364	7	17.953	21	9.198		
	7	75	17.415	27	22.710				
	8	75	16.565	10	22.710				
	9	75	4.531						
	10	75	4.203						
0602A2	11	74	3.738	10	3.936				
	12	74	3.766	15	4.559				
	1	75	4.531	12	4.106				
	2	75	4.214						
	3	75	3.054						
	4	75	4.134	19	4.448				
	5	75	10.575	4	2.039	18	15.093		
	6	75	13.762	7	21.288	21	3.341		
	7	75	16.792	27	19.709				
	8	75	16.225	10	22.031				
	9	75	2.888						
	10	75	4.243						

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 04/26/78

LAKE CODE 0602 HOCA RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0602R1	11	74	0.042	10	0.042				
	12	74	0.042	15	0.045				
	1	75	0.037						
	2	75	0.059						
	3	75	0.212						
	4	75	0.510						
	5	75	1.076	18	0.941				
	6	75	0.017	21	0.0				
	7	75	0.008	27	0.006				
	8	75	0.006	10	0.006				
	9	75	0.003	6	0.006				
	10	75	0.006						
0602C1	11	74	0.017						
	12	74	0.017	15	0.020				
	1	75	0.014						
	2	75	0.023						
	3	75	0.079						
	4	75	0.190	6	0.127	19	0.142		
	5	75	0.396	4	0.170	18	0.224		
	6	75	0.006	7	0.006	21	0.003		
	7	75	0.003	27	0.003				
	8	75	0.003	10	0.003				
	9	75	0.0	6	0.003				
	10	75	0.003						
0602Z2	11	74	0.059						
	12	74	0.059						
	1	75	0.051						
	2	75	0.082						
	3	75	0.283						
	4	75	0.708						
	5	75	1.472						
	6	75	0.023						
	7	75	0.011						
	8	75	0.006						
	9	75	0.003						
	10	75	0.008						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

060201
39 24 59.0 120 05 24.0 3
BOCA LAKE
06057 CALIFORNIA

11EPALES 760109 2111202
0046 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/09	09 55	0000	14.8	8.2	69	59	7.90	44	0.050	0.300	0.020K	0.018K
	09 55	0005	14.6	9.4		58	8.00	44	0.040	0.200	0.020K	0.019K
	09 55	0015	10.9	9.8		52	8.00	43	0.020	0.200	0.020K	0.020K
	09 55	0031	7.5	9.6		49	7.20	44	0.040	0.200	0.020K	0.020K
	09 55	0041	6.6	8.6		48	8.10	44	0.020	0.200	0.020K	0.018K
75/06/30	11 07	0000	13.1	8.2	144	54	7.80	42	0.020	0.300	0.020K	0.002
	11 07	0005	13.1	8.2		54	7.90	42	0.030	0.200K	0.020K	0.002K
	11 07	0015	13.1	9.0		53	7.95	43	0.020	0.200K	0.020K	0.003
	11 07	0035	10.3	9.4		55	7.80	40	0.030	0.200K	0.020K	0.007
75/11/04	15 10	0000	12.0	9.2	168	31	8.00	32	0.020K	0.200K	0.020K	0.002K
	15 10	0005	12.0	9.4		31	8.00	30	0.020K	0.200K	0.020K	0.002K
	15 10	0020	12.0	9.4		31	8.00	24	0.020K	0.200K	0.020K	0.002K

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/09	09 55	0000	0.012	1.2	
	09 55	0005	0.012		
	09 55	0015	0.011		
	09 55	0031	0.011		
	09 55	0041	0.011		
75/06/30	11 07	0000	0.016	0.9	
	11 07	0005	0.016		
	11 07	0015	0.020		
	11 07	0035	0.027		
75/11/04	15 10	0000	0.012	3.5	
	15 10	0005	0.011		
	15 10	0020	0.011		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060202
39 23 33.0 120 05 46.0 3
BOCA LAKE
06057 CALIFORNIA

11EPALES 760109 2111202
0068 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/06/09	10 25	0000	15.6	9.0	78	60	8.10	44	0.020	0.300	0.020K	0.022K
	10 25	0005	15.4	9.2		60	8.00	33	0.030	0.200	0.020K	0.015
	10 25	0020	9.7	9.2		51	8.00	32	0.030	0.300	0.020K	0.021K
	10 25	0041	7.4	9.6		49	8.10	32	0.030	0.200K	0.020K	0.016
	10 25	0064	6.3	9.0		45	7.20	35	0.050	0.200K	0.020K	0.023
75/06/30	10 30	0000	12.5	9.0	148	56	7.75	36	0.030	0.400	0.020K	0.004
	10 30	0005	12.3	9.4		55	7.90	38	0.020	0.200K	0.020K	0.003
	10 30	0015	11.2	8.6		52	7.85	38	0.020	0.300	0.020K	0.002
	10 30	0025	8.7	9.6		51	7.70	36	0.020	0.200K	0.020K	0.004
	10 30	0045	7.1	9.4		45	7.60	39	0.020	0.200K	0.020K	0.003
	10 30	0065	7.0	9.2		42	7.50	40	0.030	0.200	0.020K	0.003
75/11/04	14 45	0000	12.2	9.2	156	37	7.90	31	0.020K	0.200K	0.020K	0.002K
	14 45	0005	11.9	9.2		33	8.00	31	0.020K	0.200K	0.020K	0.002K
	14 45	0015	11.8	9.2		33	7.85	30	0.020K	0.200K	0.020K	0.002K
	14 45	0035	11.6	8.8		33	7.70	30	0.020K	0.200K	0.020K	0.002K
	14 45	0067	11.6	8.8		33	7.75	34	0.020K	0.200K	0.020K	0.002K

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/09	10 25	0000	0.013	1.0	
	10 25	0005	0.011		
	10 25	0020	0.010		
	10 25	0041	0.012		
	10 25	0064	0.014		
75/06/30	10 30	0000	0.014	1.0	
	10 30	0005	0.015		
	10 30	0015	0.014		
	10 30	0025	0.016		
	10 30	0045	0.019		
	10 30	0065	0.018		
75/11/04	14 45	0000	0.009	2.6	
	14 45	0005	0.011		
	14 45	0015	0.009		
	14 45	0035	0.010		
	14 45	0067	0.011		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/09/24

0602A1
39 23 10.0 120 05 40.0 4
LITTLE TRUCKEE RIVER
06 7.5 BOCA
0/BOCA RESERVOIR 150191
SEC RD BRDG .2 MI BELOW BOCA DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	12 00		0.010	0.900	0.020	0.005	0.010K
74/12/15	14 40		0.008	0.300	0.009	0.005K	0.010K
75/01/12	11 00		0.008	0.100	0.012	0.005	0.010
75/03/09	13 30		0.005	0.650	0.015	0.005	0.020
75/04/06	13 30		0.120	0.150	0.015	0.010	0.030
75/04/19	10 20		0.080	3.750	0.085		0.030
75/05/04	12 30		0.025	0.200	0.010	0.005	0.010K
75/05/18	15 00		0.015	0.150	0.065	0.025	0.040
75/06/07	13 50		0.075	0.550	0.255	0.005K	0.010K
75/06/21	14 15		0.010	1.250	0.055	0.010	0.030
75/07/27	13 15		0.010	0.200	0.045	0.007	0.020
75/08/10	12 05		0.020	0.100	0.015	0.005K	0.010
75/09/06	10 30		0.025	0.300	0.045	0.005K	0.010
75/10/18	11 30		0.015	0.200	0.015	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0602A2
39 26 10.0 120 05 00.0 4
TRUCKEE RIVER
06 7.5 BOCA
T/BOCA RESERVOIR 150191
BNK OFF STAMPEDE MEADOWS RD 3.9 M N BOCA
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	11 30		0.080	0.100K	0.015	0.005	0.010K
74/12/15	14 25		0.008	0.100K	0.007	0.005K	0.010
75/01/12	10 30		0.008	0.150	0.008	0.005K	0.010K
75/04/19	09 40		0.010	0.450	0.025		0.010K
75/05/04	11 45		0.020	0.400	0.020	0.010	0.010
75/05/18	14 35		0.015	0.100	0.020	0.005	0.020
75/06/07	13 05		0.070	0.150	0.055	0.020	0.030
75/06/21	13 00		0.005	1.600	0.045	0.005K	0.020
75/07/27	11 15		0.010	0.100	0.020	0.005	0.010K
75/08/10	10 00		0.020	0.250	0.015	0.005K	0.020
75/09/05	08 45		0.010	0.300	0.075	0.015	0.040
75/10/19	10 30		0.075	0.200	0.020	0.005	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060281
39 29 50.0 120 06 05.0 4
DRY CREEK
06 7.5 BOCA
T/BOCA RESERVOIR 150191
UNMPRVD RD XING 3 MI N OF BOCA
.11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10 30		0.010	1.300	0.035	0.010	0.010
74/12/15	13 30		0.008	0.100	0.008	0.011	0.025
75/07/27	12 00		0.005	0.050	0.015	0.010	0.020
75/08/10	11 00		0.005		0.010	0.010	
75/09/06	09 45		0.010	0.300	0.065	0.005K	0.020
75/10/18	11 15		0.005	0.400	0.035	0.010	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

IORET RETRIEVAL DATE 76/09/24

0602C1
39 24 20.0 120 05 05.0 4
E BOCA CANYON CREEK
06 7.5 BOCA
T/BOCA RESERVOIR 150191
LGHT QTY RD BRDG 1.5 MI N OF BOCA
11E-ALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/15	14	10	0.190	1.050	0.064	0.045	0.100
75/03/09	12	30	0.020	2.600	1.720	0.050	0.070
75/04/06	13	00	0.010	1.200	0.020	0.035	0.050
75/04/19	10	00	0.015	1.600	0.025	0.045	0.050
75/05/04	12	05	0.005	0.300	0.010	0.040	0.040
75/05/18	14	45	0.010	0.900	0.020	0.055	0.070
75/06/07	13	30	0.085	0.300	0.030	0.050	0.060
75/06/21	13	20	0.005	0.400	0.055	0.050	0.080
75/07/27	11	30	0.005	0.500	0.030	0.040	0.070
75/08/10	10	20	0.010		0.030	0.040	
75/09/06	09	00	0.050	0.100K	0.040	0.005K	0.010
75/10/18	10	45	0.005	0.400	0.015	0.045	0.075

K VALUE KNOWN TO BE
LESS THAN INDICATED